MC8141P User's manual
4-Axis Stepping/Pulse-type Servo Motor Control Card
2nd Edition

Aurotek Corporation

Acknowledgments
Aurotek is a trademark of Aurotek Corp. IBM and PC are trademarks of International Business Machines Corporation. MS-DOS, Windows®, Microsoft® Visual C++ and Visual BASIC are trademarks of Microsoft® Corporation. Intel® and Pentium® are trademarks of Intel Corporation. Delphi and C++Builder are trademarks of Inprise Corporation.

CE notification
The MC8141P, developed by AUROTEK CORP., has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Aurotek. Please contact your local supplier for ordering information.

Technical Support
For technical support and service, please contact us:

Fl. 2, No. 123, Wugung 1st Rd., Wugu Industrial District, Taipei 248, Taiwan
Tel: +886-2-2299-3955 (rep.)
Fax: +886-2-2218-1989
E-mail: info@robot.com.tw

2nd Edition
Printed in Taiwan March 2003

Contents

1. Introduction

The MC8141P 4-Axis Stepping/Pulse-type Servo Motor Control Card is designed for general-purpose extreme motion applications. The MC8141P is a high-speed 4-Axis motion control card for the PCI bus that simplifies stepping and pulse-type servo motor control, giving you added performance from your motors. The card's intelligent NOVA® MCX314-motion ASIC builds in a variety of motion control functions, such as 2/3-axis linear interpolation, 2-axis circular interpolation, T/S-curve acceleration/deceleration rate and more. In addition, the MC8141P performs these motion control functions without processor load during driving.

For advanced applications, we supply Windows DLL drivers and user friendly examples to decrease your programming load. Moreover, through a free bundled MC8141P motion utility, you can complete configuration and diagnosis easily.

1.1 Features

The Aurotek MC8141P provides users with the most requested motor control functions as seen below:

- Independent 4-axis motion control
- Support hand wheel and jog function
- 2/3-axis linear interpolation function
- 2-axis circular interpolation function
- Continuous interpolation function
- Programmable T/S-curve acceleration and deceleration
- Up to 4MPPS pulse output for each axis
- Two pulse output types: Up/Down or Pulse/Direction
- Up to 1 MHz encoder input for each axis
- Two encoder pulse input types: A/B phase or Up/Down
- Position management and software limit switch function
- Board ID
- Free Motion Utility bundled for configuration and diagnosis

The Aurotek MC8141P offers the following main features:

Individual Control for 4 Axes
Each of the four axes has identical function capabilities, and is controlled by the same method of operation with constant speed, trapezoidal or S curve driving.

Programmable T/S-curve Acceleration and Deceleration
Each of four axes can be preset individually with S-curve or trapezoidal acceleration/deceleration rates. When using S-curve acceleration to control driving speed, output pulse is generated in parabolic-shaped acceleration or deceleration curves, and the triangular curve phenomenon will not occur through the NOVA® MCX314-motion ASIC design concept.

Linear and Circular Interpolation
Any two or three axes can be selected to execute linear interpolation driving and any two axes can be selected to execute circular arc interpolation control. The interpolation speed range is from 1 PPS to 4 MPPS.

Powerful position management function
Each axis is equipped with a 32-bit logical position counter and a 32-bit real position counter. The

logical position counter counts the axis' pulse output number and the real position counter is recorded with the feedback pulse from the outside encoder or linear scale.

Speed Control
The speed range of the pulse output is from 1PPS to 4MPPS for constant speed, trapezoidal or S-curve acceleration/deceleration driving. The accuracy of the frequency of the pulse output is less than +/- 0.1% (at CLK=16 MHz). The speed of driving pulse output can be freely changed during the driving.

Bit Pattern Interpolation
Any 2 or 3 axes can be selected to perform the bit pattern interpolation, and the interpolation data is calculated by CPU; CPU writes the bit data into MCX314. Then, MCX314 outputs pulses continuously at the preset driving speed. So, the user can process any interpolation curve by this mode.

Continuous Interpolation
Different interpolation methods can be used continuously, for example: Linear interpolation →Circular interpolation →Linear interpolation The maximum driving speed of performing continuous interpolation is 2MPPS.

Constant Vector Speed Control
This function performs a constant vector speed. During the interpolation driving, MCX314 can set a 1.414 times pulse cycle for 2-axis simultaneous pulse output, and a 1.732-time pulse cycle for 3-axis simultaneous pulse output that keep the constant speed during driving.

Position Control
Each axis has a 32-bit logic position counter and a 32-bits real position counter. The logic position counter counts the output pulse numbers, and the real position counter counts the feedback pulse numbers from the external encoder or linear scale.

Compare Register and Software Limit
Each axis has two 32-bit compare registers for logical position counter and real position counter. The comparison result can be read from the status registers. The comparison result can be notified by an interrupt signal. These registers can be also functioned as software limits.

Driving by External Signal
It is possible to control each axis by external signals. The +/- direction fixed pulse driving and continuous driving can be also performed through the external signals. This function is used for JOG or teaching modes, and will share the CPU load.

Input/ Output Signal
Each axis has 4 points of input signals to perform deceleration and stop in driving. These input signals are for high-speed near-by home search, home search and z-phase search during the home returning. Each axis is with 8 output points for general output.

Servo Motor Feedback Signals
Each axis includes input pins for servo feedback signals such as in-positioning, close loop positioning control and servo alarm.

Interrupt Signals
Interrupt signals can be generated when: (1). The start / finish of a constant speed drive during the trapezoidal driving, (2). The end of driving, and (3). The compare result once higher / lower the border-lines of the position counter range. An interrupt signal can be also generated during the interpolation driving.

Real Time Monitoring
During the driving, the present status such as logical position, real position, drive speed, acceleration /

deceleration, status of accelerating / decelerating and constant driving can be read.

1.2 Applications

- Precise X-Y-Z position control
- Precise rotation control
- Packaging and assembly equipment
- Machine control with up to 4 axes
- Semiconductor pick and place and testing equipment
- Other stepping/pulse-type servo motor applications

1.3 Installation Guide

Before you install your MC8141P card, please make sure you have the following necessary components:

- MC8141P DAS card
- MC8141P's User's Manual
- Driver Software Aurotek — MC8141P DLL drivers (Included in the companion CD-ROM)
- Motion Utility Aurotek — MC8141P Motion Utility (Included in the companion CD-ROM)
- Wiring cable — FX2B-100S -1.27R(1.2m)
- Wiring board — PCN5050D (2pcs)
- Computer — Personal computer or workstation with a PCI-bus slot

After you have got the necessary components and maybe some accessories for enhanced operation of your Motion card, you can then begin the Installation procedures.

1.4 Accessories

Aurotek offers a complete set of accessory products to support the MC8141P card. These accessories include:

Wiring Cable

- FX2B-100S -1.27R(1.2m) — The FX2B-100S -1.27R cable is specially designed for MC8141P card.

Wiring Boards

- PCN5050D — The PCN5050D is a 50-pin wiring terminal module for DIN-rail mounting. This terminal module can allow easy yet reliable access to individual pin connections for the MC8141P card.

2. Installation

This chapter gives users a package item checklist, proper instructions about unpacking and step-by-step procedures for both driver and card installation.

2.1 Unpacking

After receiving your MC8141P package, please inspect its contents first. The package should contain the following items:

☑ **MC8141P card**
☑ **Companion CD-ROM (DLL driver included)**
☑ **User's Manual**

The MC8141P card harbors certain electronic components vulnerable to *electrostatic discharge* (ESD). ESD could easily damage the integrated circuits and certain components if preventive measures are not carefully paid attention to. ***Before removing the card from the antistatic plastic bag, you should take following precautions to ward off possible ESD damage:***

- Touch the metal part of your computer chassis with your hand to discharge static electricity accumulated on your body. Or one can also use a grounding strap.
- Touch the antistatic bag to a metal part of your computer chassis before opening the bag.
- Take hold of the card only by the metal bracket when removing it out of the bag.

After taking out the card, first you should:

- Inspect the card for any possible signs of external damage (loose or damaged components, etc.). If the card is visibly damaged, please notify our service department or our local sales representative immediately. Avoid installing a damaged card into your system.

Also pay extra caution to the following aspects to ensure proper installation:

- Avoid physical contact with materials that could hold static electricity such as plastic, vinyl and Styrofoam.

- Whenever you handle the card, grasp it only by its edges. DO NOT TOUCH the exposed metal pins of the connector or the electronic components.

Note:

- Keep the antistatic bag for future use. You might need the original bag to store the card if you have to remove the card from PC or transport it elsewhere.

2.2 Driver Installation

We recommend you to install the driver before you install the MC8141P card into your system, since this will guarantee a smooth installation process.

The 32-bit DLL driver Setup program for the card is included on the companion CD-ROM that is shipped with your DAS card package. Please follow the steps below to install the driver software:

Step 1: Insert the companion CD-ROM into your CD-ROM drive.

Step 2: The Setup program will be launched automatically if you have the autoplay function enabled on your system. When the Setup Program is launched, you'll see the following Setup Screen.

Note:

✎ If the autoplay function is not enabled on your computer, use Windows Explorer or Windows Run command to execute SETUP.EXE on the companion CD-ROM.

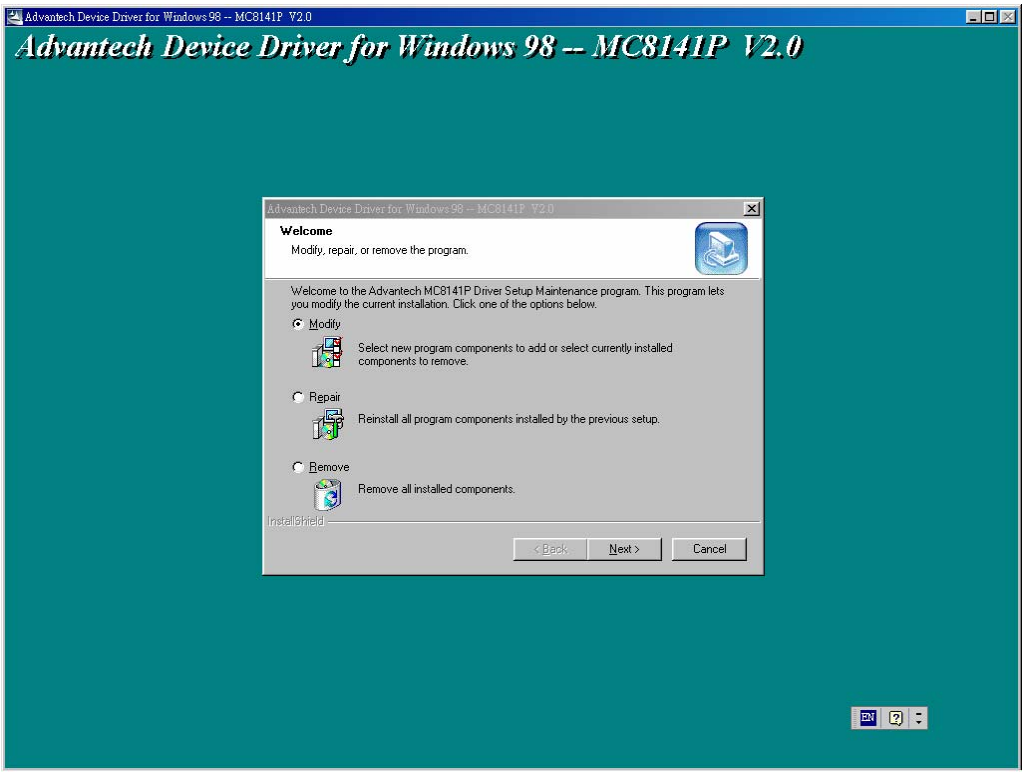


Figure 2-1: The Setup Screen of Aurotek Automation Software

Step 3: Just follow the installation instructions step by step to complete your DLL driver setup.

Step 4: Then setup the MC8141P Motion Utility automatically. For further information on driver-related issues, an online version of Software Manual is available by accessing the following path:

Start/Programs/Aurotek MC8141P Driver

The example source codes could be found under the corresponding installation folder such as the default installation path:

\Program Files\Aurotek\MC8141P\Examples

2.3 Hardware Installation

Note:

✎ Make sure you have installed the driver first before you install the card (please refer to *2.2 Driver Installation*)

After the DLL driver installation is completed, you can now go on to install the MC8141P card in any PCI slot on your computer. But it is suggested that you should refer to the computer user manual or related documentations if you have any doubt. Please follow the steps below to install the card on your system.

Step 1: Turn off your computer and unplug the power cord and cables.

- TURN OFF your computer before installing or removing any components on the computer.

Step 2: Remove the cover of your computer.

Step 3: Remove the slot cover on the back panel of your computer.

Step 4: Touch the metal part on the surface of your computer to neutralize the static electricity that might be on your body.

Step 5: Insert the MC8141P card into a PCI slot. Hold the card only by its edges and carefully align it with the slot. Insert the card firmly into place. Use of excessive force must be avoided, otherwise the card might be damaged.

Step 6: Fasten the bracket of the PCI card on the back panel rail of the computer with screws.

Step 7: Connect appropriate accessories (68-pin cable, wiring terminals, etc. if necessary) to the PCI card.

Step 8: Replace the cover of your computer chassis. Re-connect the cables you removed in step 2.

Step 9: Plug in the power cord and turn on the computer.

3. Signal Connections

Maintaining signal connections is one of the most important factors in ensuring that your application system is sending and receiving data correctly.

A good signal connection can avoid unnecessary and costly damage to your PC and other hardware devices. This chapter provides useful information about how to connect input and output signals to the MC8141P via the I/O connector.

3.1 I/O Connector Pin Assignments

The I/O connector on the MC8141P is a 100-pin connector that enables you to connect to accessories with the FX2B-100S-1.27R cable.

Figure 3-1 shows the pin assignments for the 100-pin I/O connector on the MC8141P, and Table 3-1 shows its I/O connector signal description.

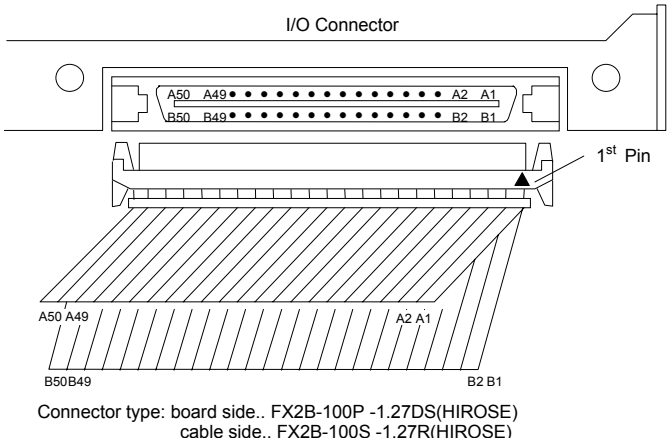


Figure 3-1: I/O connector pin for the MC8141P

Note:

- See the figure above: when the first pin (▲) is found, the upper cable, from right (red wire) to left are the pins A1, A2, A3, …, A49, A50, and lower cable from right (red wire) to left are the pins B2, B3, …, B49, B50.
- The FX2B-100S-1.27R cable is especially designed for the MC8141P to reduce noise in the analog signal lines. Please refer to Section 1.4 Accessories.

3.2 Location of Jumpers and DIP switch

Figure 3-2 shows the names and locations of jumpers and DIP switch on the MC8141P. There are nine jumpers, JP1 to JP9 on the MC8141P. Please refer to Section 3.4 Output Pulse Definition and Section 3.11 Emergency Stop Input for more information about JP1~8 and JP9 configurations.

Board ID

The MC8141P has a built-in DIP switch (SW1), which is used to define each card's board ID for MC8141P Motion Utility. You can determine the board ID on the register as shown on Table 3-2. When there are multiple cards on the same chassis, this board ID setting function is useful for identifying each card's device number through board ID. We set the MC8141P board ID as 0 at the factory. If you need to adjust it to other board ID, set the SW1 by referring to the Table 3-3.

Table 3-1: MC8141P I/O Connector Signal Description (part 1)

Pin	Signal Name	I/O	Contents
A1	VEX	Input	External Power(DC12~24V)
A2	EMG	Input	Emergency Stop (for all axes)
A3	XLMT+	Input	+ Direction Limit of X axis
A4	XLMT-	Input	- Direction Limit of X axis
A5	XIN1	Input	Decelerating / Sudden Stop of X axis
A6	XIN2	Input	Decelerating / Sudden Stop of X axis
A7	XIN3	Input	Decelerating / Sudden Stop of X axis
A8	YLMT+	Input	+ Direction Limit of Y axis
A9	YLMT-	Input	- Direction Limit of Y axis
A10	YIN1	Input	Decelerating / Sudden Stop of Y axis
A11	YIN2	Input	Decelerating / Sudden Stop of Y axis
A12	YIN3	Input	Decelerating / Sudden Stop of Y axis
A13	XINPOS	Input	Servo In-positioning of X axis
A14	XALARM	Input	Servo Error of X axis
A15	XECAP	Input	Encoder Phase A of X axis
A16	XECAN	Input	Encoder Phase A of X axis
A17	XECBP	Input	Encoder Phase B of X axis
A18	XECBN	Input	Encoder Phase B of X axis
A19	XIN0P	Input	Encoder Phase Z of X axis
A20	XIN0N	Input	Encoder Phase Z of X axis
A21	YINPOS	Input	Servo In-positioning of Y axis
A22	YALARM	Input	Servo Error of Y axis
A23	YECAP	Input	Encoder Phase A of Y axis
A24	YECAN	Input	Encoder Phase A of Y axis
A25	YECBP	Input	Encoder Phase B of Y axis
A26	YECBN	Input	Encoder Phase B of Y axis
A27	YIN0P	Input	Encoder Phase Z of Y axis
A28	YIN0N	Input	Encoder Phase Z of Y axis
A29	XEXOP+	Input	+ Direction Drive Operation of X axis
A30	XEXOP-	Input	– Direction Drive Operation of X axis
A31	YEXOP+	Input	+ Direction Drive Operation of Y axis
A32	YEXOP-	Input	– Direction Drive Operation of Y axis
A33	GND		Ground
A34	XOUT4	Output	General Purpose Output of X axis
A35	XOUT5	Output	General Purpose Output of X axis
A36	XOUT6	Output	General Purpose Output of X axis
A37	XOUT7	Output	General Purpose Output of X axis
A38	XP+P	Output	+ Direction Drive Pulse of X axis
A39	XP+N	Output	+ Direction Drive Pulse of X axis
A40	XP-P	Output	- Direction Drive Pulse of X axis
A41	XP-N	Output	- Direction Drive Pulse of X axis
A42	GND		Ground
A43	YOUT4	Output	General Purpose Output of Y axis
A44	YOUT5	Output	General Purpose Output of Y axis
A45	YOUT6	Output	General Purpose Output of Y axis
A46	YOUT7	Output	General Purpose Output of Y axis
A47	YP+P	Output	+ Direction Drive Pulse of Y axis
A48	YP+N	Output	+ Direction Drive Pulse of Y axis
A49	YP-P	Output	- Direction Drive Pulse of Y axis
A50	YP-N	Output	- Direction Drive Pulse of Y axis

Table 3-1: MC8141P I/O Connector Signal Description (part 2)

Pin	Signal Name	I/O	Contents
B1	VEX	Input	External Power (DC12~24V)
B2			
B3	ZLMT+	Input	+ Direction Limit of Z axis
B4	ZLMT-	Input	- Direction Limit of Z axis
B5	ZIN1	Input	Decelerating / Sudden Stop of Z axis
B6	ZIN2	Input	Decelerating / Sudden Stop of Z axis
B7	ZIN3	Input	Decelerating / Sudden Stop of Z axis
B8	ULMT+	Input	+ Direction Limit of U axis
B9	ULMT-	Input	- Direction Limit of U axis
B10	UIN1	Input	Decelerating / Sudden Stop of U axis
B11	UIN2	Input	Decelerating / Sudden Stop of U axis
B12	UIN3	Input	Decelerating / Sudden Stop of U axis
B13	ZINPOS	Input	Servo In-positioning of Z axis
B14	ZALARM	Input	Servo Error of Z axis
B15	ZECAP	Input	Encoder Phase A of Z axis
B16	ZECAN	Input	Encoder Phase A of Z axis
B17	ZECBP	Input	Encoder Phase B of Z axis
B18	ZECBN	Input	Encoder Phase B of Z axis
B19	ZIN0P	Input	Encoder Phase Z of Z axis
B20	ZIN0N	Input	Encoder Phase Z of Z axis
B21	UINPOS	Input	In-positioning of U axis
B22	UALARM	Input	Servo Error of U axis
B23	UECAP	Input	Encoder Phase A of U axis
B24	UECAN	Input	Encoder Phase A of U axis
B25	UECBP	Input	Encoder Phase B of U axis
B26	UECBN	Input	Encoder Phase B of U axis
B27	UIN0P	Input	Encoder Phase Z of U axis
B28	UIN0N	Input	Encoder Phase Z of U axis
B29	ZEXOP+	Input	+ Direction Drive Operation of Z axis
B30	ZEXOP-	Input	– Direction Drive Operation of Z axis
B31	UEXOP+	Input	+ Direction Drive Operation of U axis
B32	UEXOP-	Input	– Direction Drive Operation of U axis
B33	GND		Ground
B34	ZOUT4	Output	General Purpose Output of Z axis
B35	ZOUT5	Output	General Purpose Output of Z axis
B36	ZOUT6	Output	General Purpose Output of Z axis
B37	ZOUT7	Output	General Purpose Output of Z axis
B38	ZP+P	Output	+ Direction Drive Pulse of Z axis
B39	ZP+N	Output	+ Direction Drive Pulse of Z axis
B40	ZP-P	Output	- Direction Drive Pulse of Z axis
B41	ZP-N	Output	- Direction Drive Pulse of Z axis
B42	GND		Ground
B43	UOUT4	Output	General Purpose Output of U axis
B44	UOUT5	Output	General Purpose Output of U axis
B45	UOUT6	Output	General Purpose Output of U axis
B46	UOUT7	Output	General Purpose Output of U axis
B47	UP+P	Output	+ Direction Drive Pulse of U axis
B48	UP+N	Output	+ Direction Drive Pulse of U axis
B49	UP-P	Output	- Direction Drive Pulse of U axis
B50	UP-N	Output	- Direction Drive Pulse of U axis

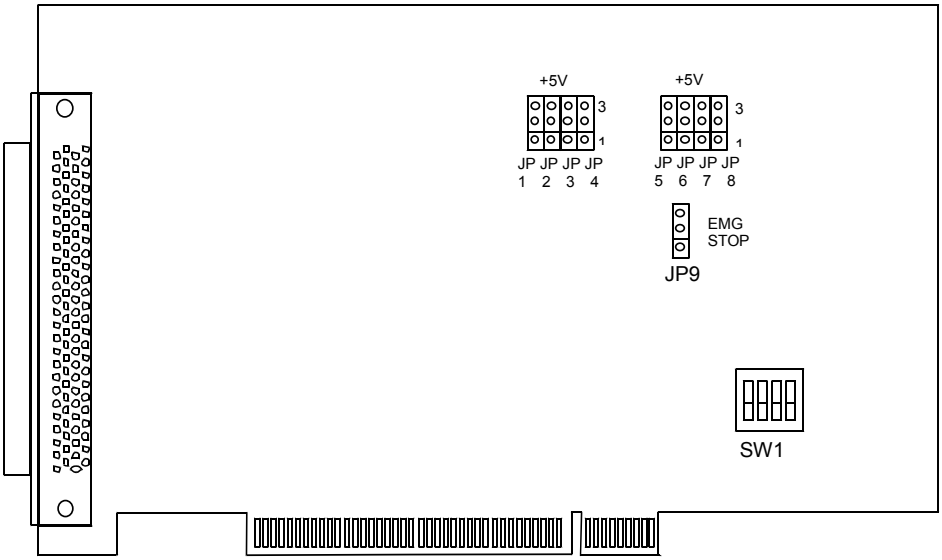


Figure 3-2: Location of Jumpers and DIP switch on MC8141P

Table 3-2: Board ID register

SW1	Board ID register			
Base Add+12h	3	2	1	0
Abbreviation	BDID3	BDID2	BDID1	BDID0

ID0: the least significant bit (LSB) of Board ID
ID3: the most significant bit (MSB) of Board ID

Table 3-3: Board ID setting

Board ID setting (SW1)				
Board ID	**Switch Position**			
	ID3	**ID2**	**ID1**	**ID0**
***0**	●	●	●	●
1	●	●	●	○
14	○	○	○	●
15	○	○	○	○

●= Off ○= On * = default

3.4 Output Pulse Definition (nP+P, nP+N, nP-P, nP-N)

The output pulse command of MC8141P is from MCX314 chip. The pulse command has two types. One is in Up/Down mode and another is in Pulse/Direction mode. While nP+P is differential from nP+N and nP-P is differential from nP-N. After system reset, the nP+P and nP-P is low level, and this invert output (nP+N, nP-N) is high level, and the default setting of pulse output mode is Up/Down. User can change the output mode into Pulse/Direction mode by writing specified command system register.

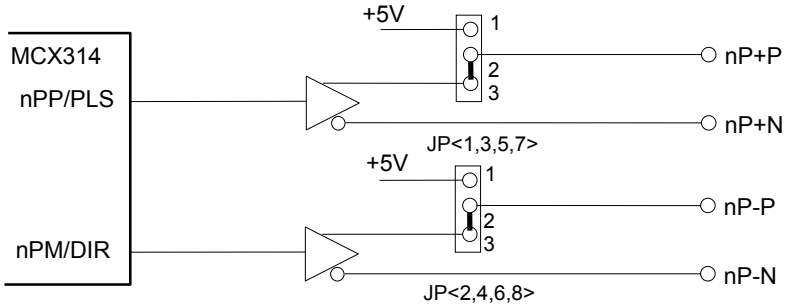


Figure 3-3: Output Signal Loop for Drive Pulses

From the circuit shown above (Figure 3-3), the default output mode is differential output. For single ended output use, user can change jumpers JP1~8 to +5V. Note that you should prevent from the noise interference when using jumpers JP1~8 to output internal +5V to external device.

Table 3-4: Jumper table of JP1~8

Jumper	JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8
Output Signal	XP+P	XP-P	YP+P	YP-P	ZP+P	ZP-P	UP+P	UP-P
IC output (Line Driver Output)	Pin 2 and Pin 3 short (Default)							
+5V output	Pin 1 and Pin 2 short							

The following figure 3-4 and 3-5 show the examples of input circuitry connection for both photo coupler and motor driver respectively.

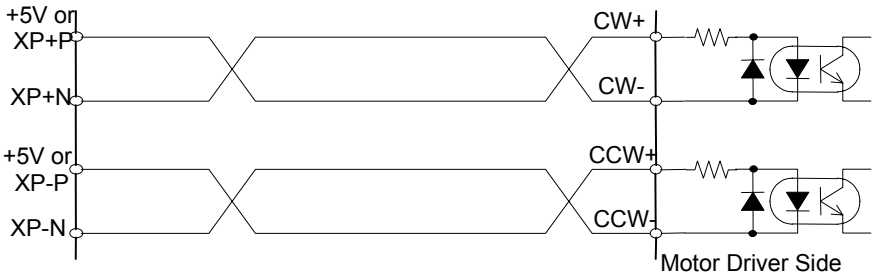


Figure 3-4: Photo coupler input interface

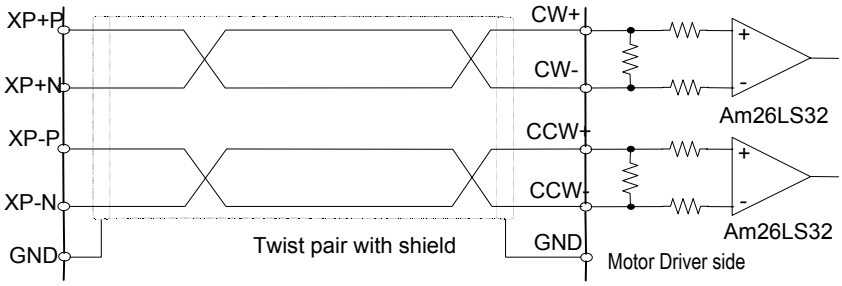


Figure 3-5: Line driver input interface

3.5 General Purposed Output (nOUT7 ~ nOUT4)

The general purposed output nOUT7/DSND, nOUT6/ASND, nOUT5/CMPM, and nOUT4/CMPP are from MCX314, and each output signal is OFF status after system reset.

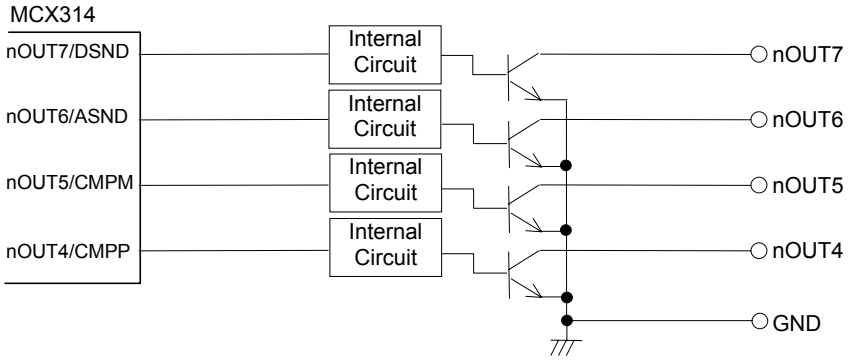


Figure 3-6: Circuit Diagram for General Purposed Output

General purposed output signals used in motor drives can clear error counter, alarm reset, stimulus off, etc., or select acceleration/deceleration for driving, position counter, and the status of comparison register as your output during driving.

Note:

- The sink current of each input is 200mA max. Please do not apply larger voltage or current exceeding these limits.

3.6 Over Traveling Limit Switch Input (nLMT+, nLMT-)

Over traveling limit switches are used for system protection. This input signal is connected to the limit input of MCX314 through the connection of photo coupler and RC filter. When the limit switch is applied, the external power VEX DC12~24V will source the photo coupler, and then the nLMTP in MCX314 will be low level. This enables the over traveling function if the desired level of nLMTP is set to low.

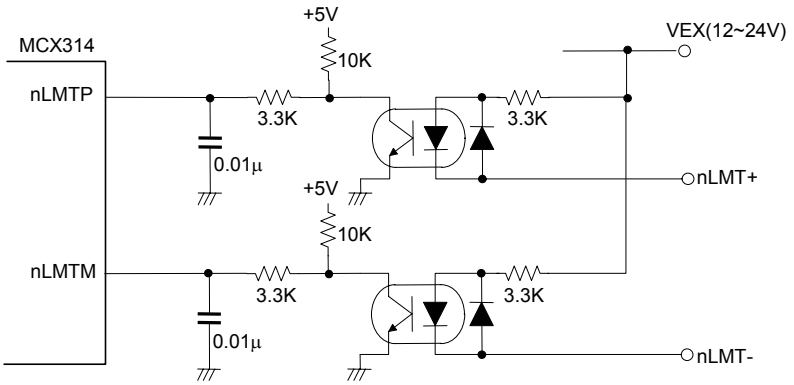


Figure 3-7: Circuit Diagram for Movement Limit Input Signals

The response time of this circuit should take about 0.2 ~ 0.4 msec because of the delay of photo coupled and RC filter. The following figure 3-8 is an example of photo sensor used in the case of over traveling limit switch input. When writing D3 bit of register2 (XWR2) into 0
to set the limit switch is low active in X-axis, the following figure can work normally.

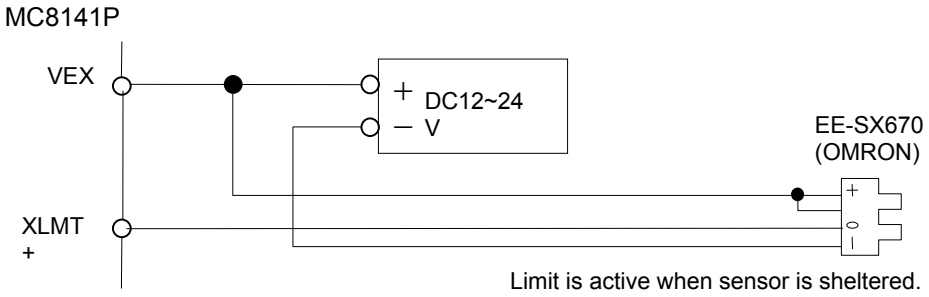


Figure 3-8: Example of photo sensor used in the limit input signal

3.7 Deceleration/Instantaneous Stop Switch Input (nIN1~3)

There are three input signals (nIN1, nIN2, nIN3) can make the motor drives deceleration or stop. Each axis has four inputs IN3 ~ IN0, wherein IN0 is used in phase Z interface of encoder feedback, and nIN1, nIN2, and nIN3 are use as input signals near the original point. If run mode is active, the output of driving pulse is terminated after those signals are enabled; The deceleration occurs during acceleration/deceleration, and it will be stopped immediately during constant drive. All the signals become invalid after reset. For example, when setting the D7 and D6 of XWR1 register to 1 and 0 (IN3 is low active), the drive will be terminated in the case of the limit switch is on and xIN3 is low. Furthermore, these input signals can be used as general purposed input because user can get the level by reading the input register status (RR4, RR5)

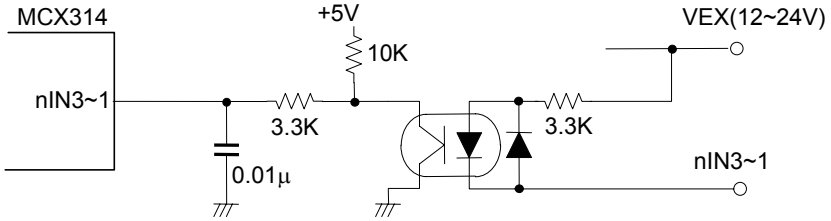


Figure 3-9: Circuit Diagram of Deceleration / Instantaneous Stop Input Signal

The response time of this circuit should take about 0.25 msec because of the delay of photo coupled and RC filter.

3.8 General Purposed Input for Servo Drives

nINPOS is an input signal from servo drives for in-position check, it is active after the servo drives finish a position command. Users can enable/disable this pin. When enable this function, the n-DRV bit in RR0 will change to 0 after servo drives finish the in-position check and nINPOS pin active.

nALARM is an input signal from servo drives for drives alarm output. When servo drives have an abnormal condition, they active this signal to note MC8141P to stop output pulses. When enable the nALARM function of MC8141P, the D14 bit of RR2 will set to 1 after nALARM active. If MC8141P is driving pulses output, the output pulses will stop immediately when nALARM active.

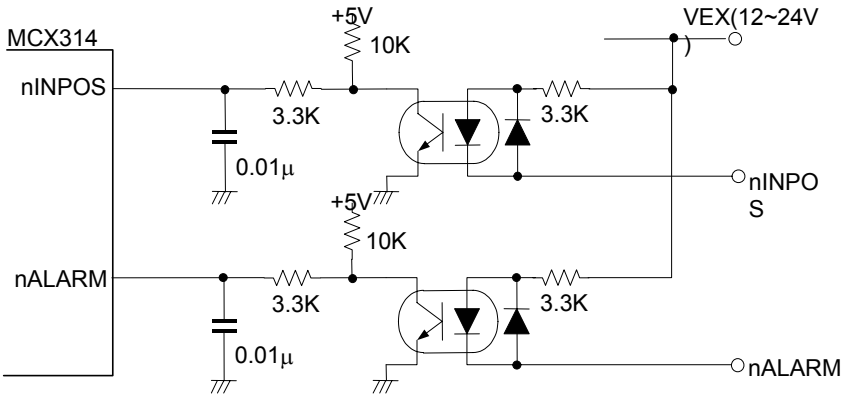


Figure 3-10: Input Signal for Servo Motor

This signal must be supplied from the external source DC12 ~ 24V, and the response time of this circuit should take about 0.25 msec because of the delay of photo coupled and RC filter.

Furthermore, this two signals can be used as general purposed input while user could read the input register 1 and 2 (RR4, RR5) to get the status of this two signal.

3.9 Encoder Input (nECAP, nECAN, nECBP, nECBN, nINOP, nINON)

When feedback the encoder signals, connect nECAP to phase A of encoder output. And nECAN to phase A, nECBP to phase B, nECBN to phase B. nIN0P to phase Z and nIN0N to phase Z. The default setting of position feedback of MC8141P is quadrature input. Up/Down pulses feedback is available after setting the input pule mode.

nIN0P/N is used for encoder phase Z signal feedback and also can be used as general purposed input or instantaneous stop input.

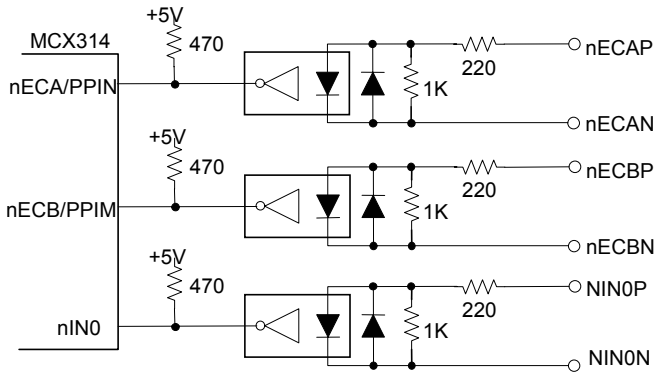


Figure 3-11: Circuit diagram of encoder feedback

From the circuit diagram above, MC8141P use high speed photo coupler for isolation. The encoder output can be differential mode or open-collector mode. When n***P is high and n***N is low, the real feedback signal (n***) to MCX314 is low. The maximum possible A/B phase feedback frequency is about 1 MHz.

The following diagram is an example of the connection for encoder with differential-output linear driver.

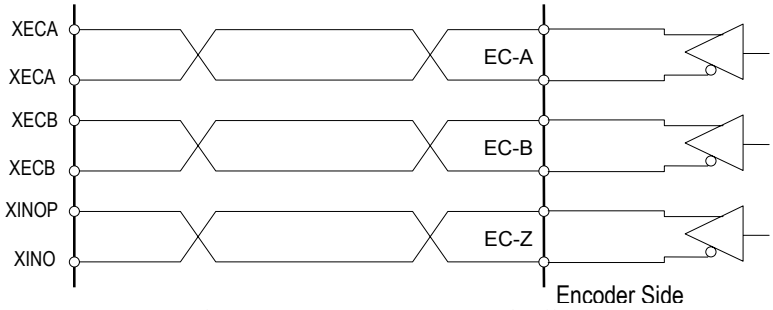
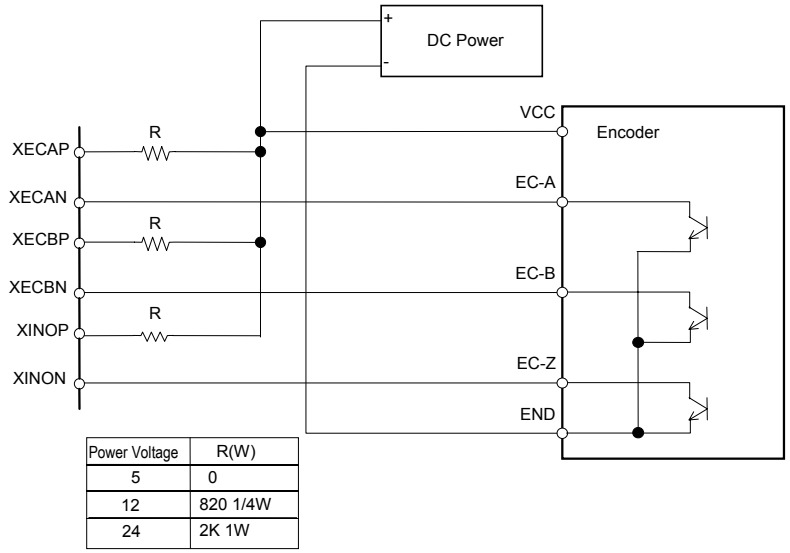


Figure 3-12: Example of the connection diagram of differential-output line driver

The following figure is an example of connection for the encoder with open-collector output.



Power Voltage	R(W)
5	0
12	820 1/4W
24	2K 1W

Figure 3-13: Example of the connection for open collector output encoder

3.10 External Pulse Control Input (nEXOP+, nEXOP-)

The pulses output function of MCX314 chip is controlled by register setting or by external pulse command input (nEXOP+, nEXOP-). There are two output pulse mode for the external control pin. One is fixed pulse output mode, and the other is continuous output mode. In MC8141P, it provides Jog and Hand wheel functions that allow you driving motors through external Hand wheel or Jog equipment. In Jog mode, it is corresponding to the “Continuous Output Mode,” and in Hand wheel mode, it is corresponding to the “Fixed Pulse Output Mode.” These functions are progressed without CPU involved on host PC. When the input signal is enabled during fixed pulse drive, the pulse specified will be output. When continuous output drive is enabled, the drive pulse will be continually output at the period of signal Low. This signal should be used in combination with external power DC12 ~ 24V. The response time of circuitry should take about 10 msec because of the delay of photo coupled and RC filter.

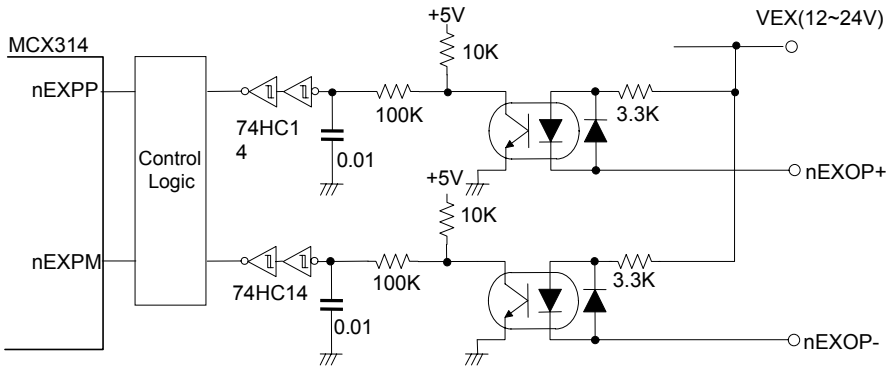


Figure 3-14: Circuit diagram of the external drive operation signals

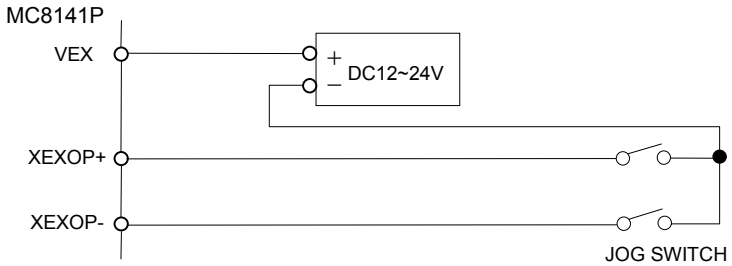


Figure 3-15: Example of connecting to Jog

3.11 Emergency Stop Input (EMG)

When emergency stop input signal is enabled, the output of the drive pulse for all axes will be stopped, and error bit of main status register will be set to 1. The operation of emergency stop input is positive or negative triggered can be determined by JP9 on the board.

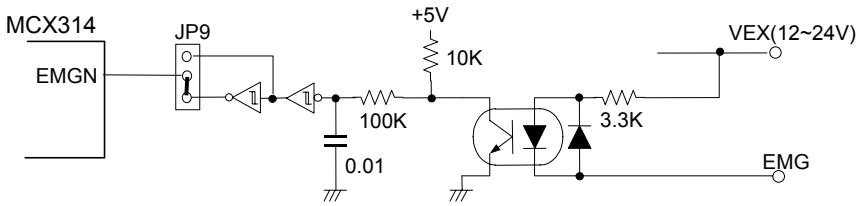


Figure 3-16: Circuit diagram of emergency stop input signal

This signal should be used in combination with external power DC12 ~ 24V. The response time of circuitry should take about 0.25 msec because of the delay of photo coupled and RC filter.

Table 3-5: Jumper table of JP9

Jumper	JP9
Emergency stop function enabled when emergency stop signal (EMG) and external GND short	Pin 1 and Pin 2 short (Default)
Emergency stop function enabled when emergency stop signal (EMG) and external GND open	Pin 2 and Pin 3 short

Note:

✎ Please check if EMG and GND are short or not when the card could not work properly.

3.12 External Power Input (VEX)

External power is necessary for all input signals of each axis. Please apply DC12~24V voltage as your need. Current consumption of each point for input signal is DC12V = 3.3 mA, DC24V = 7 mA.

3.13 Interrupt Setting

When the interrupt occurs from MCX314, the interrupt signal of MCX314 will be changed from high to low. Because the PCI bus interrupt is high level sensitive, the MC8141P inverse the signal and latch the signal to adapt the PCI bus INTA. The Fig- 3.17 shows the interrupt structure of the MC8141P. We suggest users who want to program their own interrupt service routine (ISR) should follow the procedures:

Step 1: When interrupt occurs. (Hardware)

Step 2: Program will jump to ISR. (Software)

Step 3: In ISR program the first thing have to do is clear interrupt for preventing hanging up the PCI bus.

Step 4: In ISR program the last thing have to do is read nRR3 of MCX314 for accepting next interrupt occurs.

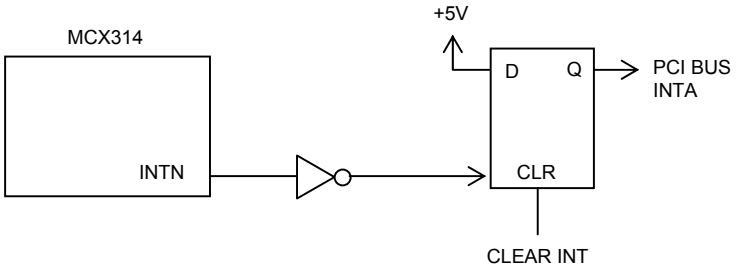


Figure 3-17: Circuit diagram of interrupt setting

3.14 Connection Examples for Motor Drivers

3.14.1 Connection to Step Motor Drivers

The following figure is an example of MC8141P connected to 5-phase micro-step motor drives, KR515M manufactured by TECHNO company.

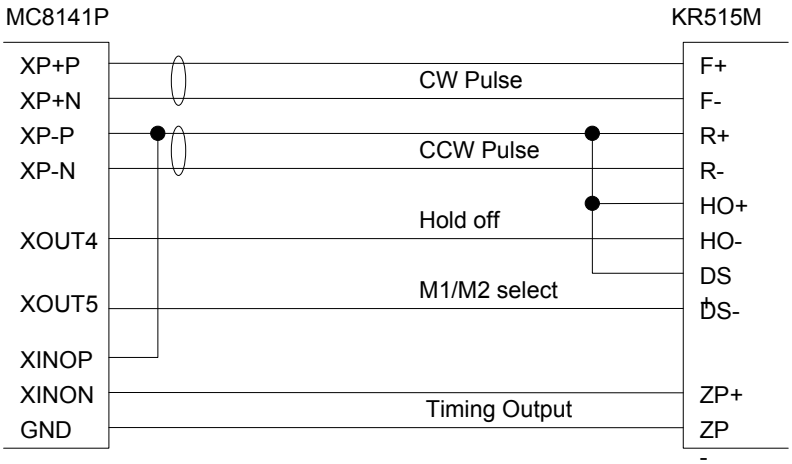


Figure 3-18: Example of connecting to KR515M drive

Note:

- JP1~8 of MC8141P are set to +5V output side, +5V output for output terminals XP+P and XP-P. Setting JP1~8 as single-ended output will output +5V of MC8141P to external devices, this will induce noise back to MC8141P. So, be careful when connection.

- Connect XOUT4 to H. O. (Hold off) can control the drive to hold.Connect XOUT5 to D.S. can control the resolution of micro-step drive. Which will be controlled by setting D8, D9 of WR3 in MCX314. And, read the RR4,5 to know the status of XIN0P/N.

The following figure is an example of MC8141P connected to UPK stepdrive manufactured by ORIENTAL company.

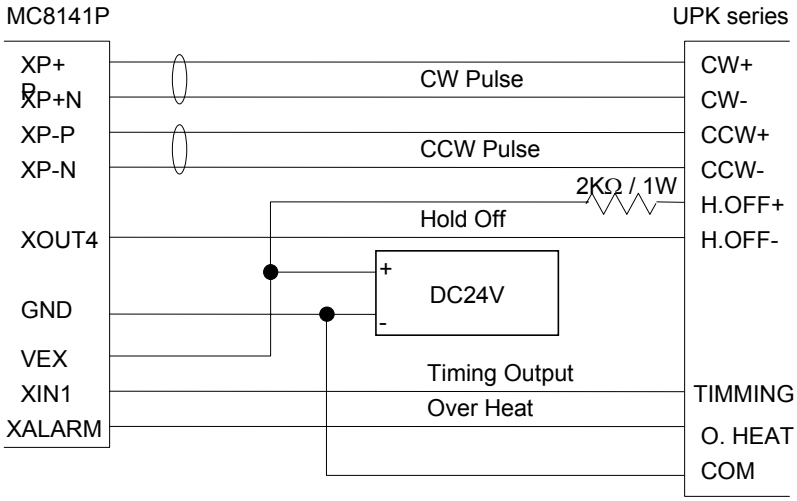


Figure 3-19: Example of connecting to UPK step drive

Note:

- The differential pulse output of MC8141P is connected to CW/CCW input of UPK drive. XOUT4 can control UPK drive to hold by setting D8 of WR3. TIMING and Over HEAT signals can be read back by reading RR4,5.
- It is better to use twist pair cable for long connection.

3.14.2 Connection to Servo Motor Drivers

The figure shown below is an example of MC8141P connected to MINAS A series AC servo motor drive.

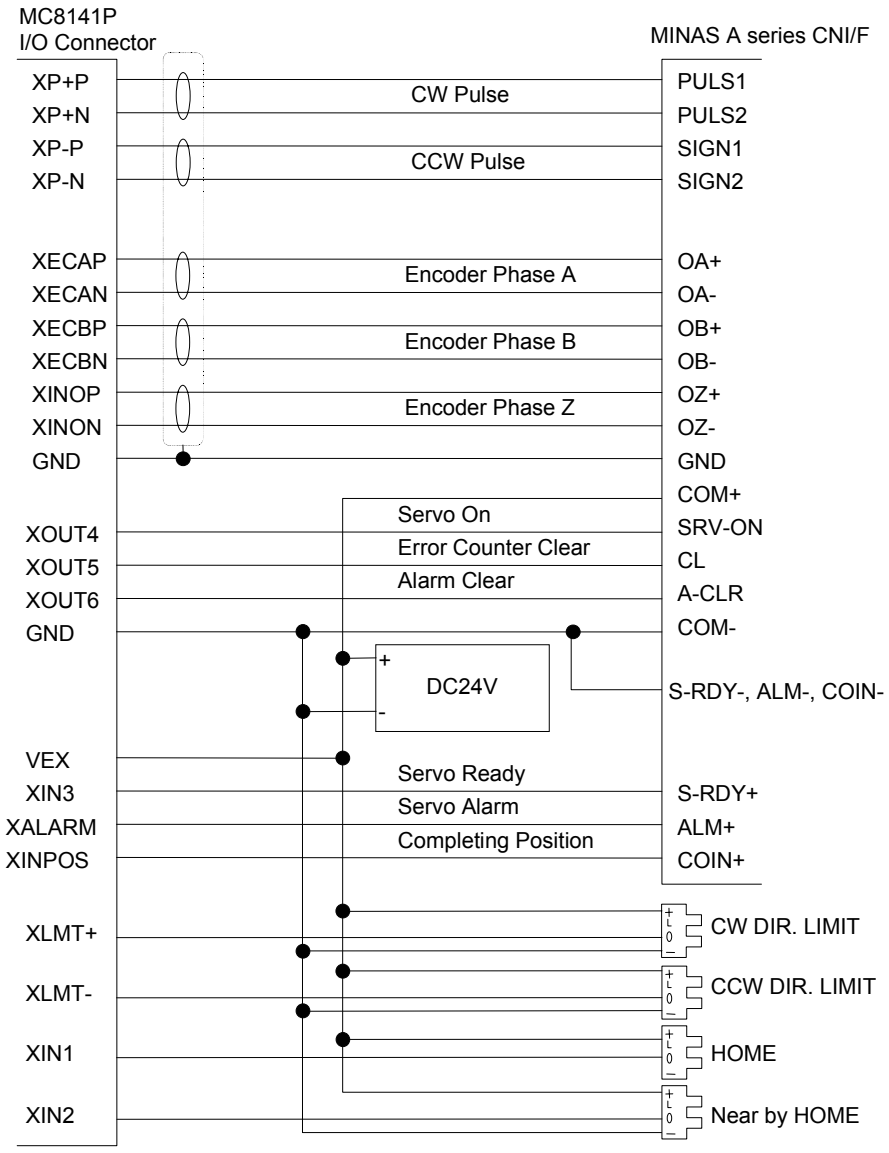


Figure 3-20: Example of connecting to MINAS A series AC servo motor drive

Note:

- The servo drive must be set in pulse-control drive mode and the type of pulse input is CW/CCW mode. This connection is not well for pulse/direction mode because the timing is not match.

- It is optional to connect encoder A/B phase feedback signal. If connect to encoder signal, user can read the real position from MC8141P.
- If the environment has high noise or the connection is long, we recommend you to use twist pair cable for servo drives.

3.15 Field Wiring Considerations

When you use the MC8141P to acquire data from outside, noises in the environment might significantly affect the accuracy of your measurements if due cautions are not taken. The following measures will be helpful to reduce possible interference running signal wires between signal sources and the MC8141P.

- The signal cables must be kept away from strong electromagnetic sources such as power lines, large electric motors, circuit breakers or welding machines, since they may cause strong electromagnetic interference. Keep the analog signal cables away from any video monitor, since it can significantly affect a data acquisition system.
- If the cable travels through an area with significant electromagnetic interference, you should adopt individually shielded, twisted-pair wires as the analog input cable. This type of cable has its signal wires twisted together and shielded with a metal mesh. The metal mesh should only be connected to one point at the signal source ground.
- Avoid running the signal cables through any conduit that might have power lines in it.
- If you have to place your signal cable parallel to a power line that has a high voltage or high current running through it, try to keep a safe distance between them. Or you should place the signal cable at a right angle to the power line to minimize the undesirable effect.
- The signals transmitted on the cable will be directly affected by the quality of the cable. In order to ensure better signal quality, we recommend that you use the FX2B-100S-1.27R cable.

3.16 I/O Signal Timing

3.16.1 Power On RESET

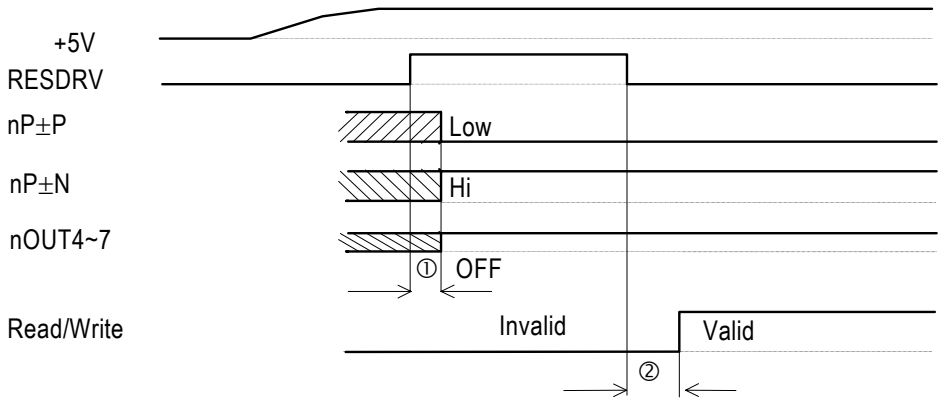


Figure 3-21: Timing diagram of Power On RESET

① Output pulses (nP ± P, nP ± N) for drive control and general purpose output signals (nOUT4 ~ 7) for I/O control will be determined after 250 nsec from power on reset.

② User can access MC8141P only after 500 nsec from power-on reset.

3.16.2 Individual Axis Driving

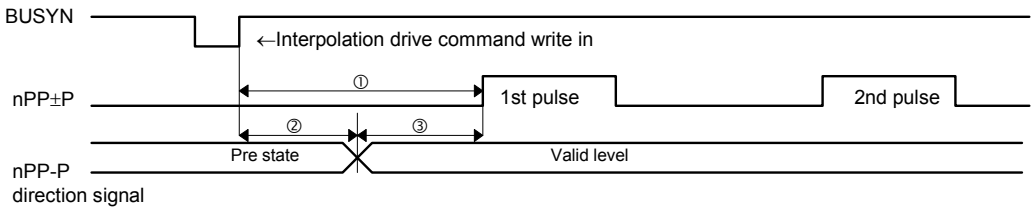


Figure 3-22: Timing diagram of Individual Axis Driving

① The maximum time to output command pulse after first pulse command is about 650nsec.

② When pulse/direction mode, the direction signal will valid after 275 nsec and pulse output will vaild after 375 nsec after direction signal.

3.16.3 Interpolation Driving

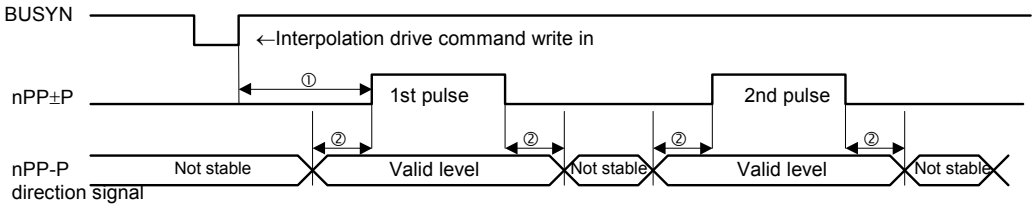


Figure 3-23: Timing diagram of Interpolation Driving

① After interpolation command is enable, the first pulse will be outputted in 775 nsec.

② If using pulse/direction mode, direction signal (nP-P) is valid in ± 125 nsec of high-level pulse signal.

3.16.4 Input Pulse Timing

- **Quadrature Pulse of Encoder Input**

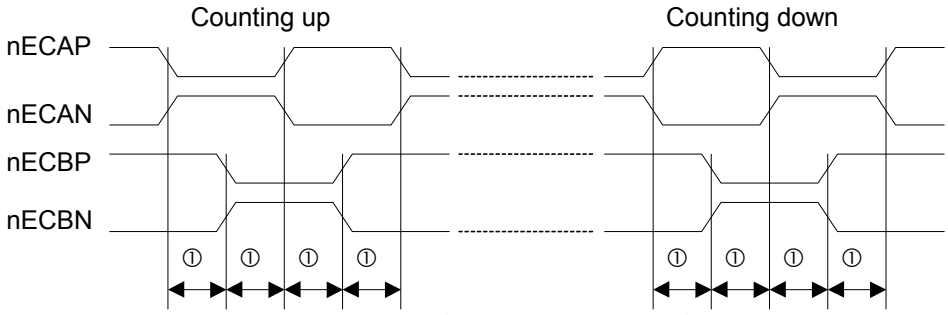


Figure 3-24: Timing diagram of Quadrature Pulse of Encoder Input

① The minimum difference time between A/B phases is 200 nsec.

■ **UP/DOWN Pulse Input**

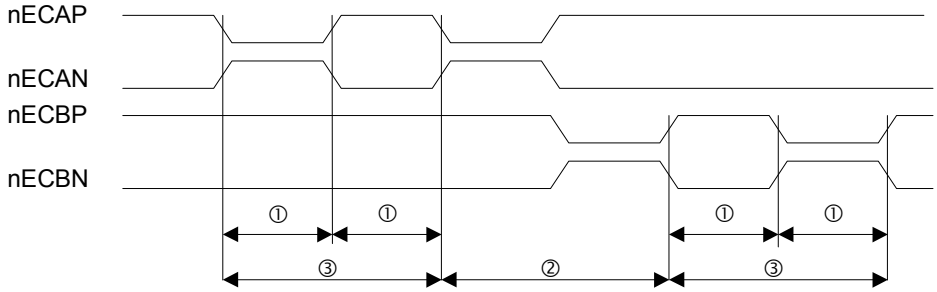


Figure 3-25: Timing diagram of UP/DOWN Pulse Input

① Minimum UP/DOWN pulse width: 130 nsec.

② Minimum Increased/Decreased Pulse Interval: 130 nsec .

③ Minimum UP/DOWN pulse period: 260 nsec.

3.16.5 Instantaneous Stop Timing

■ **External Instantaneous Stop Signal**

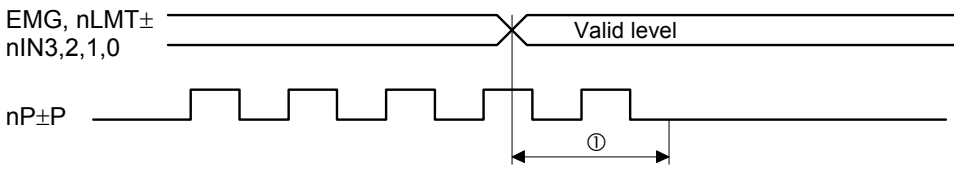


Figure 3-26: Timing diagram of External Instantaneous Stop Signal

① When external stop signal is enabled during driving, up to 400 m SEC + 1 pules will be outputted, and then stopped.

■ **Instantaneous Stop Instruction**

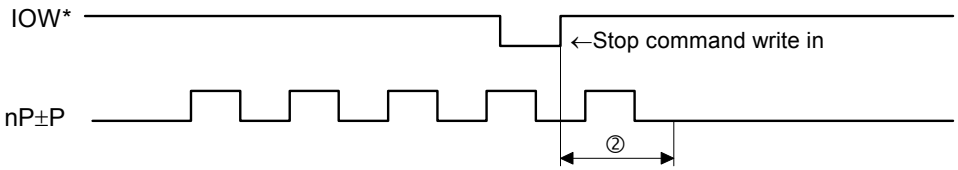


Figure 3-27: Timing diagram of Instantaneous Stop Instruction

① When the Stop instruction is issued during driving, at most one pulse will be outputted, and then stopped.

3.16.6 Deceleration Stop Timing

■ **External Deceleration/Stop Signal**

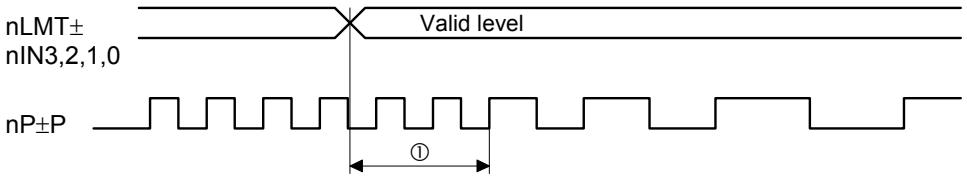


Figure 3-28: Timing diagram of External Deceleration/Stop Signal

① When external deceleration signal is enabled during driving, up to 400 m SEC + 2 pules will be outputted, and then stopped.

■ **Deceleration/Stop Instruction**

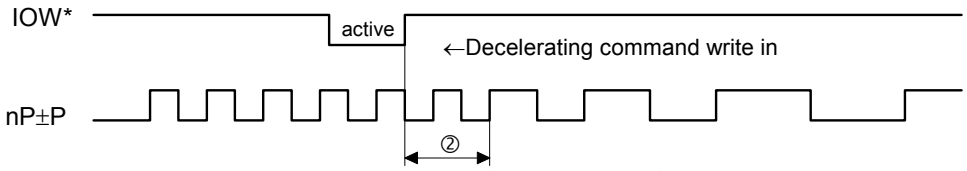


Figure 3-29: Timing diagram of Deceleration/Stop Instruction

② When the Deceleration/Stop instruction is issued during driving, at most two pulses will be outputted, and then stopped.

Appendix A. Specification

Axis:

Number of Axis	4 Axis	
2/3-Axis Linear Interpolation	Range	-8,388,608~+8,388,607 for each axis
	Speed	1PPS~4MPPS
	Precision	±0.5LSB
2-Axis Circular Interpolation	Range	-8,388,608~+8,388,607 for each axis
	Speed	1PPS~4MPPS
	Precision	±1LSB
Continuous Interpolation	Speed	1PPS~2MPPS
Drive Output Pulses	Output Signal*	nP+P/N, nP-P/N
	Range	1PPS~4MPPS
	Precision	±0.1%
	Jerk for S Curve	954~31.25 x 10^9 PPS/sec^2
	Acceleration/Deceleration	125~500 x 10^6 PPS/sec
	Initial Velocity	1PPS~4MPPS
	Drive Speed	1PPS~4MPPS
	Number of Output Pulses	0~268,435455 (fixed pulse driving mode)
	Pulse Output type	Pulse/Direction(1-pulse, 1-direction type) or CW/CCW(2-pulse type)
	Output Signal Modes	Differential line driving output/ Single-ended output
	Speed Curve	T/S-curve Acceleration/Deceleration

Encoder Input:

Encoder Interface	Input Signal*	nECAP/N, nECBP/N, nIN0P/N	
	Encoder Pulse Input Type	Quadrature (A/B phase) or Up/Down	
	Counts per Encoder Cycle	x1, x2, x4 (A/B phase only)	
	Max. Input Frequency	1 MHz	
	Input Voltage	Low	Low 3 VDC max.
		High	10 VDC min.
			30 VDC max.
	Protection	2,500 VDC isolation	

Digital Input/Output:

Input Signal	Over Traveling Limit Switch Input*	nLMT+ and nLMT-	
	External deceleration/instantaneous Stop Signal*	nIN1 ~ 3	
	Input Signal for Servo Motor Drives*	nALARM (servo alarm); INPOS (position command completed)	
	Emergency Stop	EMG - one emergency stop input	
	Max. Input Frequency	4 kHz	
	Input Voltage	Low	3 VDC max.
		High	10 VDC min.
			50 VDC max.
	Input Current	10 VDC	1.70 mA (typical)
		12 VDC	2.10 mA (typical)
		24 VDC	4.40 mA (typical)
		48 VDC	9.00 mA (typical)
		50 VDC	9.40 mA (typical)
	Protection	2,500 VDC photo coupler isolation and RC filtering	
General Purposed Output Signal	Output Signal*	nOUT4 ~ 7	
	Output Voltage	Open Collector 5 ~ 40 VDC	
	Sink Current	200 mA max./channel	
	Protection	2,500 VDC photo coupler isolation	

External Driving:

External Signals Driving	Input Signal*	nEXOP+, nEXOP Max.	
	Max. Input Frequency	100 Hz	
	Input Voltage	Low	3VDC max.
		High	10 VDC min.
			30 VDC max.
	Driving Mode	Fixed pulse driving or continuous Driving Supports Hand Wheel / Jog	
	Protection	2,500 VDC photo coupler isolation	

Other Functions:

Position Counter (read/write at any time)	Range of Command Position Counter (for output pulse)	-2,147,483,648 ~ +2,147,483,647
	Range of Actual Position Counter (for input pulse)	-2,147,483,648 ~ +2,147,483,647
Comparison Register	COMP+ Register Range	-2,147,483,648 ~ +2,147,483,647
	COMP- Register Range	-2,147,483,648 ~ +2,147,483,647
	Can be used for software over traveling limit	
Interrupt Functions (Excluding Interpolation)	Interrupt Condition (All conditions could be enable/disable individually)	Counter ≥ COMP-
		Counter < COMP-
		Counter < COMP+
		Counter ≥ COMP+
		Constant speed begin or end during acceleration/deceleration driving, pulse finished
Board ID	4-bit DIP switch, ID: 0 ~ 15	

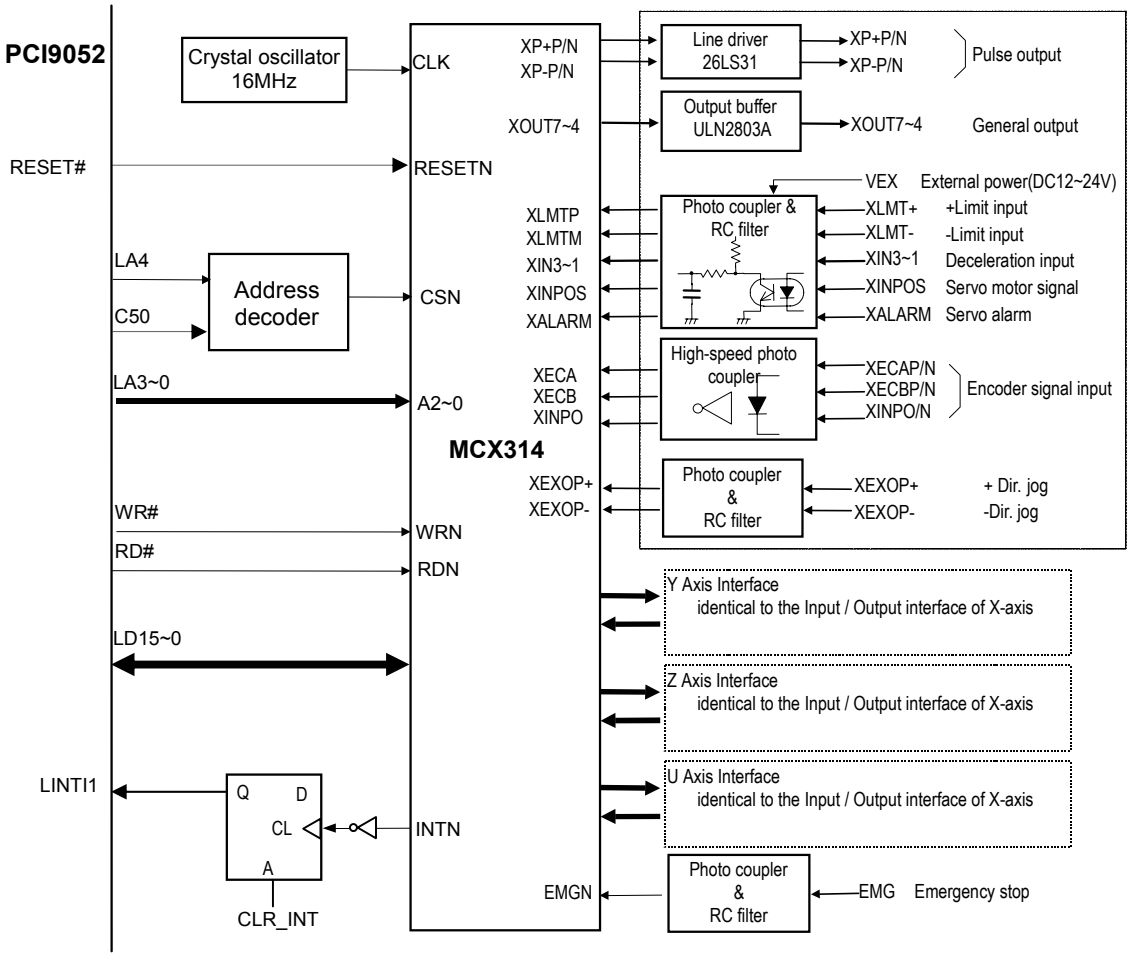
General:

I/O Connector Type	100-pin SCSI-II female	
Dimensions	175 mm x 100 mm (6.9" x 3.9")	
Power Consumption	Typical	+5V @ 850mA ; +12V @ 600mA
	Max.	+5V @ 1A ; +12V @ 700mA
External Power Voltage	DC +12 ~ 24 V	
Temperature	Operation	0 ~ +60º C (32 ~ 140º F) (refer to IEC 68-2-1,2)
	Storage	-20 ~ +85º C (-4~ 185º F)
Relative Humidity	5 ~ 95% RH non-condensing (refer to IEC 68-2-3)	
Certification	CE certified	

Note:

✎ *: “n” represents the axis (X, Y, Z or U) that is concerned

Appendix B. Block Diagram



Appendix C. Register Structure and Format

C.1 Overview

The MC8141P is delivered with an easy-to-use 32-bit DLL driver for user programming under Windows operating system. We advise users to program the MC8141P using 32-bit DLL driver provided by Aurotek to avoid the complexity of low-level programming by register.

The most important consideration in programming the MC8141P at the register level is to understand the function of the card's registers. The information in the following sections is provided for users who would like to do their own register-level programming.

C.2 I/O Port Address Map

The MC8141P requires 20 consecutive addresses in the PC's I/O space. The address of each register is specified as an offset from the card's base address. For example, BASE+0 is the card's base address and BASE+8 is the base address plus eight bytes. The following sections give the detailed information about register layout, and also the detailed information about each register or driver and its address relative to the card's base address.

Table C-1 and C-2 show the function and format of each WRITE register or driver and its address relative to the card's base address; Table C-3 and C-4 show the function and format of each READ register or driver and its address relative to the card's base address

Note

- All base address is in hexadecimal in Appendix C.
- Users have to use a 16-bit (word) I/O command to read/write each

Table C-1: MC8141P WRITE register function

Address (HEX.)	Write		
	Symbol	**Register Name**	**Content**
0	WR0	Command Register	Settings for axis assignment and command
2	XWR1 YWR1 ZWR1 UWR1	X Axis Mode Register 1 Y Axis Mode Register 1 Z Axis Mode Register 1 U Axis Mode Register 1	Enable/disable deceleration and set deceleration level. Enable/disable interrupt for each axis.
4	XWR2 YWR2 ZWR2 UWR2	X Axis Mode Register 2 Y Axis Mode Register 2 Z Axis Mode Register 2 U Axis Mode Register 2	Set the external limit signal of each axis. Set the type of output pulse Set the type of encoder input Enable/disable the signal from servo drives
	BP1P	BP1P Register	Setting for the + direction bit data of the first axis for bit pattern interpolation.
6	XWR3 YWR3 ZWR3 UWR3	X Axis Mode Register 3 Y Axis Mode Register 3 Z Axis Mode Register 3 U Axis Mode Register 3	Settings for manual deceleration, individually decelerating, and S-curve acceleration/ deceleration mode of each axis. Setting for external operation mode. Setting for general output OUT7 ~ 4.
	BP1M	BP1M Register	Setting for the - direction bit data of the first axis for bit pattern interpolation.
8	WR4	Output Register	Setting for general output OUT3 ~ 0
	BP2P	BP2P Register	Setting for the + direction bit data of th second axis for bit pattern interpolation
A	WR5	Interpolation Mode Register	Axis assignment. Settings of constant linear speed, step output mode, and interrupt
	BP2M	BP2M Register	Setting for the - direction bit data of the second axis for bit pattern interpolation
C	WR6	Data Writing Register 1	Setting of the least significant 16-bit (D15-D0) for data writing
	BP3P	BP3P Register	Setting for the + direction bit data of the third axis for bit pattern interpolation
E	WR7	Data Writing Register 2	Setting of the most significant 16-bit (D31-D16) for data writing.
	BP3M	BP3M Register	Setting for the - direction bit data of the third axis for bit pattern interpolation.
10	CLRINT	Clear Interrupt Register	Clearing the interrupt register
12	N/A	N/A	
14	PGM	Pulse Generator Mode Register	Setting for Jog/Hand wheel mode funtion

Table C-2: MC8141P WRITE register format

Base Add.		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
0	W	Command Register : WR0															
		RESET				U	Z	Y	X								
						Axis Assignments						Command Code					
2	W	Mode Register 1 : WR 1															
		D-END	C-STA	C-END	P≥c+	P<C+	P<C-	P≥c-	PULSE	IN3-E	IN3-L	IN2-E	IN2-L	IN1-E	IN1-L	IN0-E	IN0-L
		Interrupt Enable / Disable								Interrupt Enable / Disable							
4	W	Mode Register 2 : WR 2															
		INP-E	INP-L	ALM-E	ALM-L	PIND1	PIND0	PINMD	DIR-L	PLS-L	PLSMD	CMPSL	HLMT-	HLMT+	LMTMD	SLMT-	SLMT+
6	W	Mode Register 3 : WR 3															
						OUT7	OUT6	OUT5	PUT4	OUTSL			EXOP1	EXOP0	SACC	DSNDE	MANLD
8	W	Output Register : WR4															
		UOUT3	UOUT2	UOUT1	UOUT0	ZOUT3	ZOUT2	ZOUT1	ZOUT0	YOUT3	YOUT2	YOUT1	YOUT0	XOUT3	XOUT2	XOUT1	XOUT0
A	W	Interpolation Mode Register : WR5															
		BPINT	CINT		CMPLS	EXPLS		LSPD1	LSPD0			AX31	AX30	AX21	AX20	AX11	AX10
		Interrupt			Step Output			Constant Vector Speed				Ax3		Ax2		Ax1	
C	W	Data Writing Register 1 : WR6															
		WD15	WD14	WD13	WD12	WD11	WD10	WD9	WD8	WD7	WD6	WD5	WD4	WD3	WD2	WD1	WD0
E	W	Data Writing Register 2 : WR7															
		WD31	WD30	WD29	WD28	WD27	WD26	WD25	WD24	WD23	WD22	WD21	WD20	WD19	WD18	WD17	WD16
10	W	Clear Interrupt Register : CLRINT															
		Clear Interrupt Register															
14	W	Pulse Generator Mode Register : PGM															
		PGMU3	PGMU2	PGMU1	PGMU0	PGMZ3	PGMU2	PGMZ1	PGMZ0	PGMY3	PGMY2	PGMY1	PGMY0	PGMX3	PGMX2	PGMX1	PGMX0

Table C-3: MC8141P READ register function

Address (HEX.)	Read		
	Symbol	**Register Name**	**Content**
0	RR0	Main status Register	Limit switch status, driving status, ready for interpolation, quadrant for circle interpolation, and the stack of BP
2	XRR1 YRR1 ZRR1 URR1	X Axis Status Register 1 Y Axis Status Register 1 Z Axis Status Register 1 U Axis Status Register 1	The result of compare, status of acceleration, and ending status.
4	XRR2 YRR2 ZRR2 URR2	X Axis Status Register 2 Y Axis Status Register 2 Z Axis Status Register 2 U Axis Status Register 2	Error message
6	XRR3 YRR3 ZRR3 URR3	X Axis Status Register 3 Y Axis Status Register 3 Z Axis Status Register 3 U Axis Status Register 3	Interrupt message
8	RR4	Input Register 1	I/O input for X- and Y-axis
A	RR5	Input Register 2	input for Z- and U-axis
C	RR6	Data Reading Register 1	Low word of Data Register (D15 ~ D0)
E	RR7	Data Reading Register 2	High word of Data Register (D31 ~ D16)
10	INTSTA	Interrupt Status Register	The Status of Interrupt Register
12	BDID	Board ID Register	The card's Board ID
14	PGSTA	Pulse Generator Status Register	Jog/Hand wheel mode function status

Table C-4: MC8141P READ register format

Base Add.		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
1	R	Main Status Register : RR0															
			BPSC1	BPSC0	ZONE2	ZONE1	ZONE0	CNEXT	I-DRV	U-ERR	Z-ERR	Y-ERR	X-ERR	U-DRV	Z-DRV	Y-DRV	Z-DRV
										Error Status of Each Axis				Driving Status of Each Axis			
2	R	Status Register 1: RR1															
		EMG	ALARM	LMT-	LMT+	IN3	IN2	IN1	IN0	ADSND	ACNST	AASND	DSND	CNST	ASND	CMP-	CMP+
		Stop Status															
4	R	Status Register 2: RR2															
												EMG	ALARM	HLMT-	HLMT+	SLMT-	SLMT+
6	R	Status Register 3: RR3															
										D-END	C-STA	C-END	P≥C+	P<C+	P<C-	P≥C-	PULSE
8	R	Input Register 1: RR4															
		Y-ALM	Y-INP	Y-EX-	Y-EX+	Y-IN3	Y-IN2	Y-IN1	Y-IN0	X-ALM	X-INP	X-EX-	X-EX+	X-IN3	X-IN2	X-IN1	X-IN0
A	R	Input Register 2: RR5															
		U-ALM	U-INP	U-EX-	U-EX+	U-IN3	U-IN2	U-IN1	U-IN0	Z-ALM	Z-INP	Z-EX-	Z-EX+	Z-IN3	Z-IN2	Z-IN1	Z-IN0
C	R	Data Reading Register 1: RR6															
		RD15	RD14	RD13	RD12	RD11	RD10	RD9	RD8	RD7	RD6	RD5	RD4	RD3	RD2	RD1	RD0
E	R	Data Reading Register 2: RR7															
		RD31	RD30	RD29	RD28	RD27	RD26	RD25	RD24	RD23	RD22	RD21	RD20	RD19	RD18	RD17	RD16
10	R	Interrupt Status Register: INTSTA															
																	INTF
12	R	Board ID Register: BDID															
														BDID3	BDID2	BDID1	BDID0
14	R	Pulse Generator Status Register: PGSTA															
		PGMU3	PGMU2	PGMU1	PGMU0	PGMZ3	PGMZ2	PGMZ1	PGMZ0	PGMY3	PGMY2	PGMY1	PGMY0	PGMX3	PGMX2	PGMX1	PCMX0

C.3 MCX314 WRITE Registers: WR0 ~ WR7

The MC8141P registers from WR0 (Base Add. + 0) to WR7 (Base Add. + E) are the same as mapping registers on MCX314 chip, and please refer to MCX314 user's manual Section 4.3 ~ Section 4.9 for detailed information.

C.4 Clear Interrupt Register: CLRINT

Write any value to this address to clear the interrupt register.

Table C-5: Clear Interrupt Register: CLRINT - Write BASE +10

Base Add.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
10	W	Clear Interrupt Register: CLRINT															
		Clear Interrupt Register															

C.5 Pulse Generator Mode/Status Register: PGM / PGSTA

The pulse generator function is powerful for users to drive specific axis by Jog or Hand wheel. There are two operation modes - Jog mode and Hand wheel mode.

In Jog mode, it is corresponding to the "Continuous Pulse Driving Mode", and in Hand wheel mode, it is corresponding to the "Fixed Pulse Driving Mode".

Please refer to MCX314 user's manual Section 2.6.1 for detailed information.

Table C-6: Pulse Generator Mode/Status Register: PGM/PGMSTA -Write/Read BASE +14

Base Add.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
14	W	Pulse Generator Mode Register : PGM															
		PGMU3	PGMU2	PGMU1	PGMU0	PGMZ3	PGMZ2	PGMZ1	PGMZ0	PGMY3	PGMY2	PGMY1	PGMY0	PGMX3	PGMX2	PGMX1	PCMX0
	R	Pulse Generator Status Register : PGSTA															
		PGMU3	PGMU2	PGMU1	PGMU0	PGMZ3	PGMZ2	PGMZ1	PGMZ0	PGMY3	PGMY2	PGMY1	PGMY0	PGMX3	PGMX2	PGMX1	PCMX0

D3 ~ 0 X-axis Pules Generator Mode Control
D7 ~ 4 Y-axis Pules Generator Mode Control
D11 ~ 8 Z-axis Pules Generator Mode Control
D15 ~ 12 U-axis Pules Generator Mode Control

.

Table C-7: Pulse Generator Mode - PGMn3

PGMn3, n=X, Y, Z or U	Meaning	Signal Type
0	Jog mode	Isolated digital input
1	Hand wheel mode	A/B phase pulse input

The following table indicates the external signal routing path. The external signals generate the pulses to drive the motor are connected to the pins nEXOP+ and nEXOP- (Please refer to the pin assignment).

Table C-8: Pulse Generator Signal Connection Mode

PGMn2	PGMn1	PGMn0	Meaning
0	0	0	Function disabled
0	0	1	Signal from pins nEXOP+/- for driving n-axis
0	1	0	Software programmable mode - Signal from pins XEXOP+/- for driving Axis selected by pins U_IN2 and U_IN1
0	1	1	Software programmable mode - Signal from pins YEXOP+/- for driving Axis selected by pins U_IN2 and U_IN1
1	0	0	Signal from pins XEXOP+/- for driving n-axis
1	0	1	Signal from pins YEXOP+/- for driving n-axis
1	1	0	Signal from pins ZEXOP+/- for driving n-axis
1	1	1	Signal from pins UEXOP+/- for driving n-axis
Note: n= X, Y, Z or U			

Table C-9: Driving Axis for Software Programmable Mode

U_IN2	U_IN1	Driving Axis
0	0	X-axis
0	1	Y-axis
1	0	Z-axis
1	1	U-axis

C.6 MCX314 READ Registers: RR0 ~ RR7

The MC8141P registers from RR0 (Base Add. + 0) to RR7 (Base Add. +E) are the same as mapping registers on MCX314 chip, and please refer to MCX314 user's manual Section 4.10 ~ Section 4.15 for detailed information.

C.7 Interrupt Status Register: INTSTA

Table C-10: Interrupt Status Register: INTSTA - Read BASE +10

Base Add.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
10	R	Interrupt Status Register: INTSTA															
																	INTF

D0 **Interrupt flag**
This bit indicates whether interrupt occurred or not.
1 means that an interrupt has occurred.

C.8 Board ID Register: BDID

BDID shows the Board ID of the MC8141P.

Table C-11: Board ID Register: BDID - Read BASE +12

Base Add.		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
12	R	Board ID Register: BDID															
														BDID3	BDID2	BDID1	BDID0